Digitalization and Artificial Intelligence (D&AI) for SDG 4

By **Mahsa Motlagh**

Bonn Alliance for Sustainability Research concluded the digitainable Thinkathon workshop's activities under the title: Digitalization and Artificial Intelligence (D&AI) for Sustainable Development, which was held online via an interactive platform, to facilitate a basis for multi-dimensional discussions on the intersection of SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all) and D&AI. In the interest of increasing awareness and adding insights on the correlation between quality education and the advancement of digital technologies, the Thinkathon workshop aimed to explore and evaluate the impact of various aspects and varieties of digital technologies' barriers and prospects on education. The central objective of focus on SDG 4 of the 2030 Agenda was to align and further deepen emerging refrains and contribute to a shared understanding of interrelations among D&AI and SDG 4 indicators. Moreover, knowledge gaps and guiding questions were developed to direct the discussions taken up toward the existing and potential interlinkages. This note presents selected highlights of dialogues on the Thinkathon participant's broader viewpoint and their understanding and practical insight of digitalization and indicators of SDG 4. We hosted in-depth discussions around the challenges we face, and the opportunities that arise from this shared global vision on education, and the crucial role technology plays in the future of inclusive and quality education while exploring the measures of equality and integrity that are crucial for the achievement of SDG 4.

> **SDG 4, with its 10 targets and 10 indicators, aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all".**

# D&AI for SDG 4 Indicators and Interlinkages

As a part of the comprehensive UN Agenda 2030, SDG4 underlines education at all levels through applying innovative instructional approaches, enabling a learner-centered outline that supports innovative, action-oriented, and transformative learning for a sustainable future for all. We live in an era of profound changes; the nature of our work is changing to more digitalization and non-routine tasks. Digitalization rapidly transforms the skills demand, creating a misfit with what learners are today taught in schools. We need to understand how we can make a digital transition happen and at the same time achieve the SDGs. Therefore, it is essential to discuss possible directions for combining D&AI and education and illustrate emerging practices. Emerging digital technologies, such as Big Data, Cloud Computing, Artificial Intelligence (AI), Internet of Things (IoT), Virtual Reality, Blockchain, and their convergence, are becoming the driving forces of change in all aspects of life and specifically education. Although quality education is at the core of the 2030 Agenda, the role of digital infrastructure, technology, and innovation for the achievement of SDG 4 was not addressed commendably in the SDG 4 targets.

The UN 2030 Agenda acknowledges Quality Education (SDG 4) as means for achieving the SDGs, with sustainability as a goal for education in target 4.7. Thinkathon discussions highlighted that sustainable development is a holistic and interconnected process that technological advances per se do not cause positive or negative impacts on it; however, digitalization's power is embedded in particular courses of action, use-cases, and the mindset behind their employment. In the Thinkathon, the Digitalization–Sustainability Matrix (DSM), developed by the digitainable team, was utilized to map the potential of D&AI for SDG 4 indicators and its use cases. SDG4's DSM as a directorial tool prompted interactive conversations on the potential of D&AI technologies' impact on SDG4 indicators.

According to the discussions facilitated by the SDG4's DSM, it is vital to revisit SDG4's indicators by asking why education is a must to achieve the ambitious 2030 Agenda and how it can be ensured in the time of digital transformation. Focusing on indicator 4.4.1: the proportion of youth/adults with information and communications technology (ICT) skills, by type of skill; the indicator reflects a forward-looking commitment by countries focusing on equitable access to TVET and expands on the quality of the learning to be ensured. As part of this Indicator, ICT skills are seen as determining the effective use of technology, and lack of proficiency is perceived as a chance for inequality to increase.

There are many ways D&AI contributes to education, such as improving access to education opportunities, personalizing the education processes, intelligent tutoring systems, and improving both the learning speed and the quality of education, reaching from primary school to higher education. On the other hand, D&AI helps forecast which jobs and professions will be disrupted by technology, which substituting demands will be created, and new skills will be needed for the future job market. Contributing to targets 4.1, 4.3, and 4.4, affordable and context-sensitive digital education promotes equal prospects for all learners and reduces inequalities by ensuring every learner has access to high-quality educational content. However, access to affordable electricity, broadband internet, and smart devices, which are prerequisites for digital education, are not equally distributed and instead may introduce new forms of inequalities.

The anatomy of digitalization for SDG4: _Ensure inclusive & equitable quality education & promote lifelong learning opportunities for all_

Legend:
- Negative relevance ✗
- No relevance ○
- Positive relevance ✓

SDG4 Indicators	Data Driven			Analytics Driven			Design Driven	
	Mobile internet technologies/ App	Block chain	Internet of Things Digital twin technologies	Big data	Cloud computing Edge computing	AI Machine learning Deep learning	Virtual/ augmented reality	Additive manufacturing 3D printing
4.1.1 Complete free primary and secondary school for all, by sex	✓	○	○ ●	✓	✓	✓	✓	○
4.2.1 Access to early childhood education and care for all, by sex	✓	○	○	✓	✓	✓	✓	○
4.2.2 Participation rate in pre-primary for all, by sex	✓	○	○ ●	✓	✓	✓	✓	○
4.3.1 Access to affordable and quality technical, vocational, tertiary and university	✓	○	○ ●	✓	✓	✓	✓	○
4.4.1 Proportion of youth and adults with technical and vocational skills for employment and entrepreneurship	✓	○	✓	✓	✓	✓	✓	✓
4.5.1 Gender disparities in education and equal access to all levels of education for all	✓	○	✓	✓	✓	✓	✓	○
4.6.1 Percentage of population proficiency in literacy and numeracy skills, by sex	✓	✓ ●	✓	✓	✓	✓ ●	✓	○
4.7.1 Extent knowledge ad skill for sustainable development in curricula and teacher education	✓	✓	✓	✓	✓	○ ●	✓	✓
4.a.1 Proportion of schools with safe learning environment and access to adequate technology, facilities and infrastructure	✓	✓	✓	✓	✓	●	✓	✓
4.b.1 Volume of official development scholarships for higher education	✓	✓	✓	✓	✓	○	○ ●	○
4.c.1 Proportion of teachers with access to quality training pre-service or in-service for teaching at the relevant level	✓	✓	✓ ●	✓	✓	●	✓ ●	✓

D&AI's potential role was also discussed concerning indicator 4.c.1; the proper and effective use of digital technology by trainers will allow the learners to improve their educational outcomes and improve digital skills. Innovative technologies do not produce innovative practice automatically; it's in the hands of the skilled experts in learning design and training the trainers beyond hardware. There is a need to enhance trainers' existing skill sets to ensure their expertise in delivering their expert content knowledge stays relevant and adapt to the rapid growth in emerging digital technologies and utilize virtual learning. Access to infrastructure and devices and upgraded education facilities (indicator 4.a.1) is necessary but not enough for the transformational process of digitalization in the education sector. We need to build both teachers' and learners' digital capacity and provide them with digital literacy (indicator 4.4.1) as well as content and tools that will drive adoption and ultimately increase access to quality education.

Debates continued on the possibilities that blockchain technology brings to the educational setting. The discussion indicated a knowledge gap on blockchain technology, its functions, and usability for SDG4.

During the workshop, we encouraged debates on the most promising use cases for blockchain in education. What could blockchain do for education? Blockchain technology has the capacity to influence education, more specifically, in higher education (Indicators 4.6.1 and 4.b.1) by transforming the record-keeping of degrees, certifications, scholarship systems, examinations, and evaluations. Blockchain can store records and provide easy access to credentials on a decentralized ledger, optimizing educational processes and individualizing learning within a conventional classroom setup. Nowadays, blockchain-enhanced advances are combined with other digital technologies such as artificial intelligence (AI) and the Internet of Things (IoT) for more intelligent solutions to create credit systems to motivate students and encourage teachers, contributing to indicators 4.a.1 and 4.c.1, to contribute to the educational process by creating new learning contents and research.

Hence, digitalization is an inevitable force for change in terms of practices, the nature of products and services, organizations, and interactions among actors. If digital technologies play such a prominent role in education and, therefore, in the achievement of SDG4, it is because they provide new ways of building, sharing, and providing access to knowledge, new service productions, advanced administration models, and institutional changes. Moreover, reaching the full potential of combining these two domains requires a significant amount of academia and practice efforts to identify the standing gaps and develop innovative designs and solutions.

What did we learn from the detailed discussion?

Thinkathon became a successful experience in applying the SDG4's DSM as an approach to motivate and structure the dialogue on the use cases of D&AI technologies for the SDG4 at the indicator level and a beneficial tool to initiate conversations among experts on such bread topics. The summary of the discussions indicated that for ensuring mindful use of digital technology and inclusive development of digital skills in education curricula, local strategies and forward-looking plans and actions should be in place to support educational leaders in enriching education infrastructures across educational institutions. Innovative guidelines and measures are needed to steer uncertain digitalization forces on the education system into a direction that builds resilience and social inclusion to serve sustainable development and diminish digital and societal divides among those who benefit and those left behind.

D&AI innovations have produced profound changes in the structure, strategy, and delivery of teaching and learning content. The main challenge is how to harmonize, standardize, and merge the educational curriculum with the help of digital technologies to promote digital literacy to build capacities to achieve sustainable development goals. The education goal of sustainable development goals has a double function. It has targets to be achieved using digital education technologies. Simultaneously, there are concerns about how digital technologies should be developed generally in the education systems.

As illustrated in the infographic below, digitalization and education have an interdependence within the sustainable development framework, which must be viewed from two-sided angles as one to be the precondition to attaining the other one. Access to affordable broadband internet and smart devices enables access to educational resources and adds to education quality by providing access to educational

content beyond geographical limitations. For instance, scalable, adaptive, and open-access online courses and educational materials could give an abundant number of learners' access to learning resources that they would not usually have in their local educational facilities. From this angle, access to technology is crucial to the success of quality education and the achievement of SDG4. On the other hand, skills to use available digital technology for educational purposes are essential and need to be inclusive and equitable. However, both perspectives have limitations and barriers subjected to learner's demographic characteristics, income levels, geographic locations, and ethnic disparities. The current reality is that learners with a lack of access and skills are under-served.
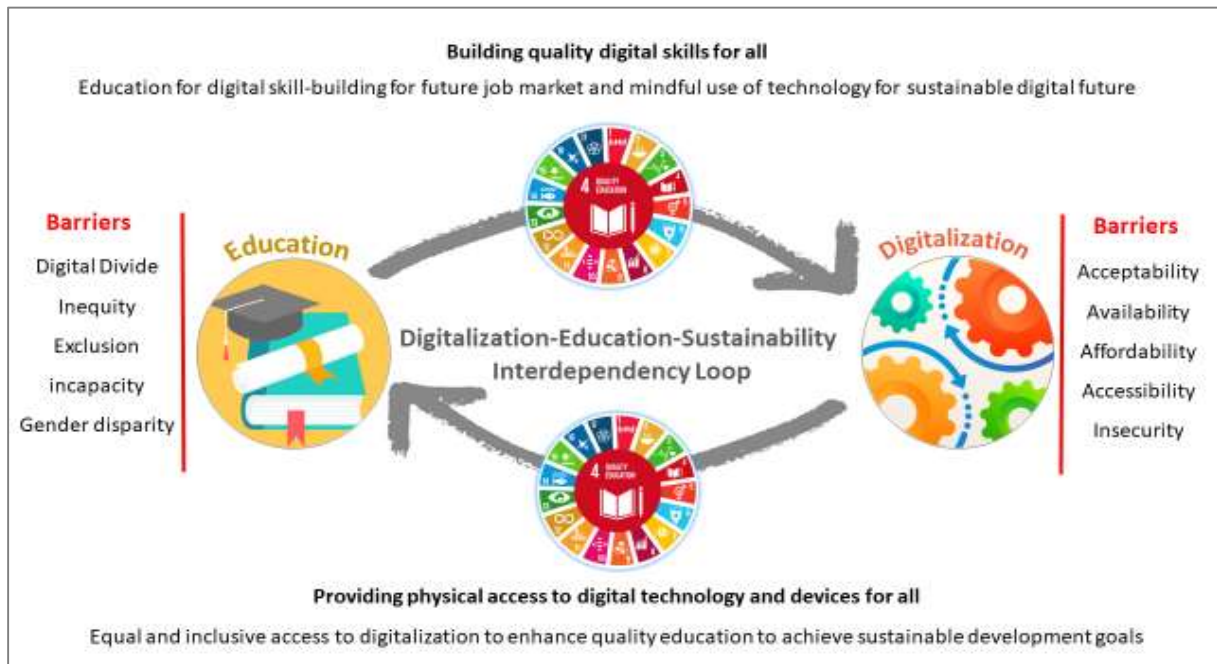
Created by Mahsa Motlagh

Under COVID-19, distance education has invaded overnight and continues. The pandemic gives technology remarkable insights into what education looks like, impose it to shift from just content dissemination to augmenting relationships with teachers' personalization and independence.

The Covid-19 pandemic has the potential to increase deficiencies and the expanding digital divide even more; precisely, it is expected to be almost overwhelming in the education sector, explicitly in countries with already lower levels of learning outcomes, high drop-out rates, and low resilience to crisis. Given the situation, investing in education technology and sustainable digital infrastructure is no longer an alternative but a necessity. Today, good governance, transparency, and accountability are considered essential factors to meet SDG4. There is a must to reconsider digital education in the post-COVID time. Considering equity in education has to bridge the digital divide and focus on education's relevance being instructed to the disadvantaged learners' well-being and marginalized communities.

The information collected and dialogue initiated in Thinkathon, using the DSM could serve as a starting point for interaction among diverse stakeholders from multiple disciplines in accessing the practical

Local classroom in Pandemic, North Iran (Photo by Mahsa Motlagh, Nov. 2020)

implications of D&AI for supporting the SDGs 4' progress. However, we identified gaps and lack of comprehensive knowledge and existing best practices on the interconnectedness of digitalization and sustainable development with respect to SDG4, which require capacity building and further improvement. More requires to be learned about whether and how the opportunities provided by D&AI could be mindfully leveraged for decent progress in education-related goals of sustainable development or could even hinder the 2030 Agenda's attainment.

The digitainable project contributes to shedding light on the dynamics of D&AI's possible impacts of D&AI on SDG indicators' and their interrelations while seeking to identify options where D&AI can enhance synergies and alleviate trade-offs. An enabling, comprehensive, and multi-dimensional framework must be developed to understand the origins of potential changes in the use of the D&AI technology being monitored and assessed to boost sustainable development goals. To expand on this, forthcoming research projects will be developed in cooperation with partners within and beyond the Bonn Alliance for Sustainability Research. If you are interested in cooperation on topics related to sustainable development, education and digitalization, please contact us.

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